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The Timber Resource of NORTH DAKOTA

by
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and
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LAKE STATES FOREST EXPERIMENT STATION
M. B. DICKERMAN · · DIRECTOR
FOREST SERVICE · · U.S. DEPARTMENT OF AGRICULTURE

THE FOREST SURVEY OF NORTH DAKOTA

This report of the first systematic forest survey in North Dakota presents estimates of forest area, volume of timber, its growth and mortality, and the amount cut. It is a part of the nationwide survey of timber resources authorized by the McSweeney-McNary Act of 1928, and conducted by the Forest Service, U. S. Department of Agriculture.

The Lake States Forest Experiment Station gratefully acknowledges assistance in collecting the data from the following: Leslie Sachow, Administration Division Chief of the Agricultural Stabilization and Conservation Office, and the many local county secretaries and their staffs; C. B. Stott, Forester, North Central Region, U. S. Forest Service; John J. Zaylskie, Extension Forester, North Dakota Agricultural College; C. N. Nelson, North Dakota State Forester; John M. Molberg, Professor, North Dakota School of Forestry; E. J. George, Silviculturist, Northern Great Plains Research Station; and Lyness Lloyd, Director, Elmer L. Worthington, Assistant Director, Soil Conservation Service, and the several Area and District Conservationists of the SCS.

Members of the Station who assisted in planning the survey or collecting the data are: M. B. Dickerman, Director; R. N. Cunningham, Chief, Division of Forest Economics; Clarence D. Chase, Field Supervisor; Suren R. Gevorkiantz, Mensurationist; Arthur G. Horn, Timber Drain Economist; and Vernon L. Lindholm, John R. Warner, Ross D. Cowan, and Paul C. Guilkey, Foresters.

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Lake States Forest Experiment Station

Forest Service, United States Department of Agriculture

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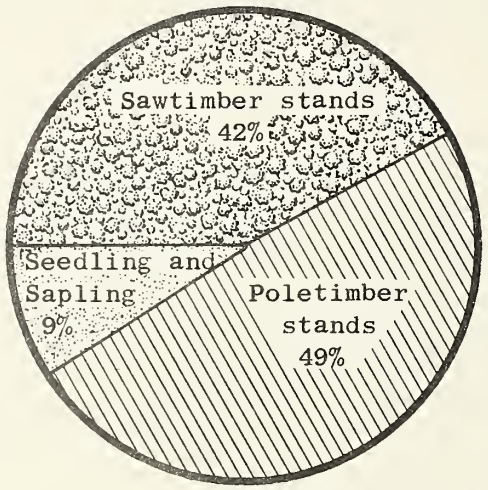
HIGHLIGHTS OF THE FOREST SURVEY FOR NORTH DAKOTA

Forests occupy 468,000 acres of the land area in North Dakota.

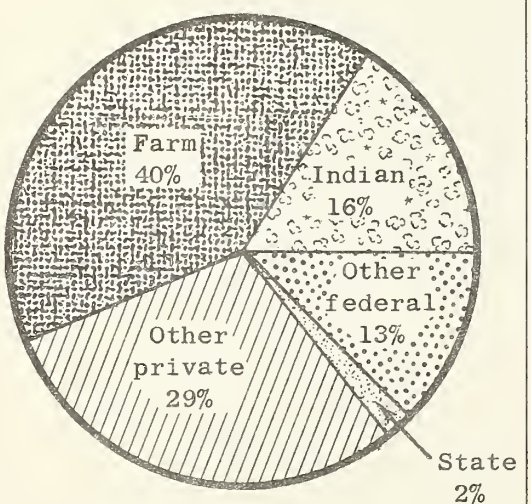
All but 16,000 acres of forest area is commercial forest land.

Lowland and upland types occupy about equal proportions of the forest land.

Forest area by stand-size class



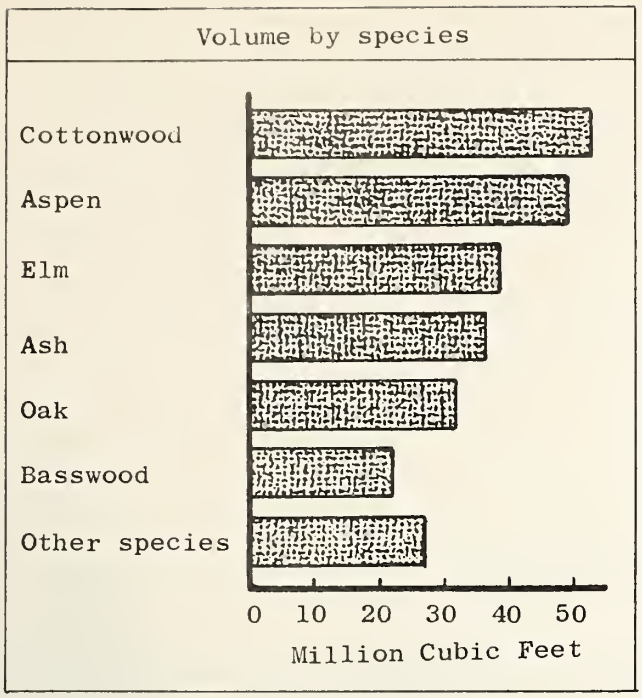
Ownership of commercial forest land



Over two-thirds of the commercial forest area is in private ownership. Forty percent is owned by farmers.

Most of the forest area under "Other Federal" ownership was acquired during the drought-stricken thirties and is now administered by the Forest Service.

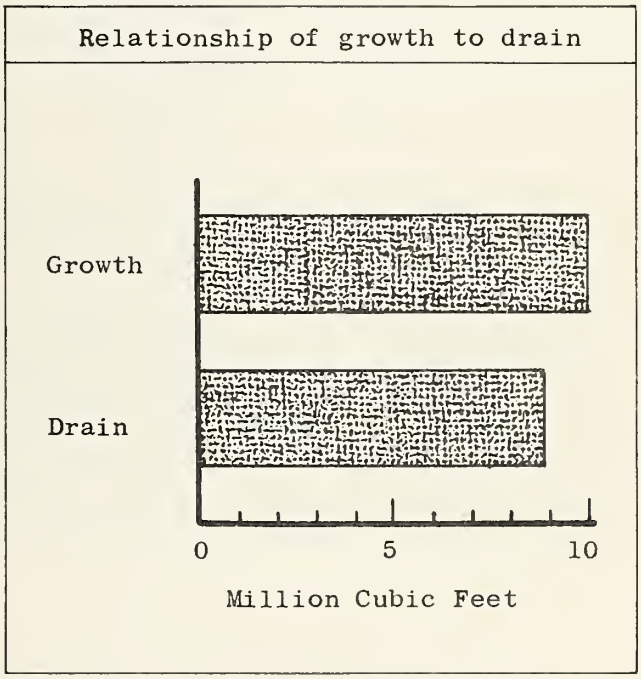
Ownership of timber volume is proportionate to area.



The total volume of growing stock is 258 million cubic feet. Of this, all but 200,000 cubic feet is in hardwood species. Cottonwood and aspen together account for nearly 40 percent of the total growing stock.

Growth of all growing stock exceeded drain by more than 10 percent during 1954.

Mortality accounted for over 60 percent of the total drain.



THE TIMBER RESOURCE OF NORTH DAKOTA

by John R. Warner and Clarence D. Chase[1/]

INTRODUCTION

North Dakota is a prairie state in the geographical center of the North American continent. Though richly endowed with a variety of mineral resources, its basic prosperity has been due to its fertile fields and abundance of grazing land. Oil is changing the picture. Its discovery and subsequent stimulation of industrial development create bright prospects for the future of the state. This type of development provides another stable element of support within a predominantly agricultural economy. The following report deals with still one other resource of value--the forests of the state.

Forests are Native to the Moister Locations

The native forests of North Dakota occur in the moister localities along stream banks, on lake shores, and in the draws and coulees of the hills. Periodic droughts are the chief factor restricting forests to their present location. More than half of the forest area is contained within two hilly sections along the Canadian border. North Dakota is one of the few states where forests occur within the geographic limits of both eastern and western timber types of the United States.

1/ Foresters at the Lake States Forest Experiment Station. The Station is maintained at St. Paul 1, Minnesota, by the Forest Service, U. S. Department of Agriculture, in cooperation with the University of Minnesota.

Use of Timber in the Past

One can only speculate as to the extent of forests during the early days of settlement, but judging from scattered statements in historical accounts they were not much more extensive than they are today.

The Mandan Indians were among the first inhabitants of North Dakota. Unique earth lodges, supported by timbers of oak, cedar, and cottonwood, were the homes of these early settlers, and it is their remains which provide us with some interesting history. Studies of these village sites, found in the valley of the Missouri River near Bismarck, indicate that the Mandans may have occupied them as early as 1200 A.D. There is good evidence that they were cutting timbers for use in construction of their earth lodges at least 450 years ago. Oak and cedar appear to have been favored, but indications are clear that by 1700 A.D. the exhausted supply of these species forced the substitution of cottonwood.

Early homesteaders used material available to them. For lack of fuelwood they burned buffalo chips and any other available combustible material; and where timber was scarce their homes were made from stones and prairie sod.

While the lack of abundant wood may have been a deterring influence to permanent settlement, the open plains early became arteries of travel to the west. The state's wood resource was an element of importance in this early period: Steamboat travel was made possible by timbered river banks which provided an abundance of fuel, and the early railroads were heavy users of timber for ties and fuel. In this connection, the Northern Pacific Railway was responsible for the only logging camp to be operated commercially in North Dakota. The trees were cut and floated down the Little Missouri River to Medora to be utilized in the construction of the Northern Pacific's main line west.

Use of Woodlands Today

Today the natural forest areas of the state provide some of its wood requirements. Although there is insufficient raw material to support forest industries of the types found in states with more woodland area, there is very positive utilization of the state's timber. For example, in 1954 (in addition to receiving the generally recognized indirect benefits of tree shelter), woodlot owners harvested 2,550,000 fence posts, 2,350,000 board feet of lumber, and 40,000 cords of fuelwood--very desirable farm assets in a prairie state.

The number of small mills which are operating in the state is uncertain, but at one time 109 North Dakotans were listed as owning sawmills. A survey conducted in 1949 by the Extension Service of North Dakota Agricultural College contacted these owners by mail questionnaires. Of the 42 respondents, 25 still had their mills; 17 had cut lumber during 1949, but only 9 of these had lumber for sale (1). The picture is still much the same. Woodlands are utilized chiefly for home consumption, and seldom are the products placed for sale. Survey data show that about 12 percent of wood cut in 1953 was manufactured into lumber, 37 percent of the cut was used for fuelwood, and 51 percent was utilized as fence posts.

Less apparent, though probably more important, are other values that have no dollar measurement. The forests not only protect watersheds, thereby minimizing erosion and flood danger, but also they shelter wildlife, help produce game for thousands of hunters, and provide picnic grounds and camp sites as well as other recreational possibilities.

Tree Planting is a Major Forestry Effort

Trees give protection from the wind. This simple fact affords them their greatest utility in North Dakota. The state's forestry activities are primarily associated with efforts toward windbreak establishment for protection of homes, cattle, and wildlife. Effective windbreaks, whether they be planted or natural, are a valuable integral part of a prairie farm.

North Dakota leads all other Plains States in the establishment of windbreak plantings. It is because of this predominating interest in protective forestry that a section of this report has been devoted to a discussion of tree-planting efforts on the prairie.

The natural establishment and growth of trees is in response to favorably combined factors of soil and climate. There is abundant proof that thousands of years ago conditions for forest development in North Dakota were more favorable than they are now. Of the factors contributing to the establishment of forests, moisture is the most critical. Today's forests are found in scattered areas of the state where soil and moisture have combined to stimulate and nurture tree growth.

Land Features and Forests

The land surface of the state rises in three broad steps from east to west. The fertile valley of the Red River, the lowest of these steps, was formed some 10,000 years ago when the receding Wisconsin ice sheet backed up a huge lake approximately 700 miles long and 200 miles wide. During this period of inundation some 20 to 30 feet of silt was deposited. Today farming predominates on this rich soil. Its table-like expanse is broken by narrow strips of woodland along stream banks and by numerous shelterbelt plantings (fig. 1) protecting its fertile fields and home sites.

Figure 1.--Shelterbelt Plantings in the Red River Valley.
(Photo through courtesy of SCS)

The second step, extending over the central portion of the state and elevated 200 to 400 feet above the old glacial lake bed, is known as the Drift Plain. It is the product of glacial deposits of gravel, sand, and finely-ground rock laid down during the last Ice Age. During one geologic era, luxuriant forests of semi-tropical trees including juniper, cypress, and sequoia covered the land. It was during this period that the extensive lignite deposits of the state were formed. The thousands of intervening years have changed this area leaving it almost devoid of tree cover (fig. 2).

The surface of the third step, known as the Missouri Plateau, extends westward to the Rocky Mountains. The eastern edge of this step, rising 300 to 400 feet above the Drift Plain and cutting north and west through the central part of the state, is the Coteau du Missouri. Near the eastern edge of this escarpment and marking the furthest advance of the Wisconsin ice sheet lies the Altamont Moraine; within it on the Missouri slope are the Badlands of the Little Missouri. This area, formed by

Figure 2.--The plains of central North Dakota.

Figure 3.--Juniper persists on the north slopes and draws in the Badlands.

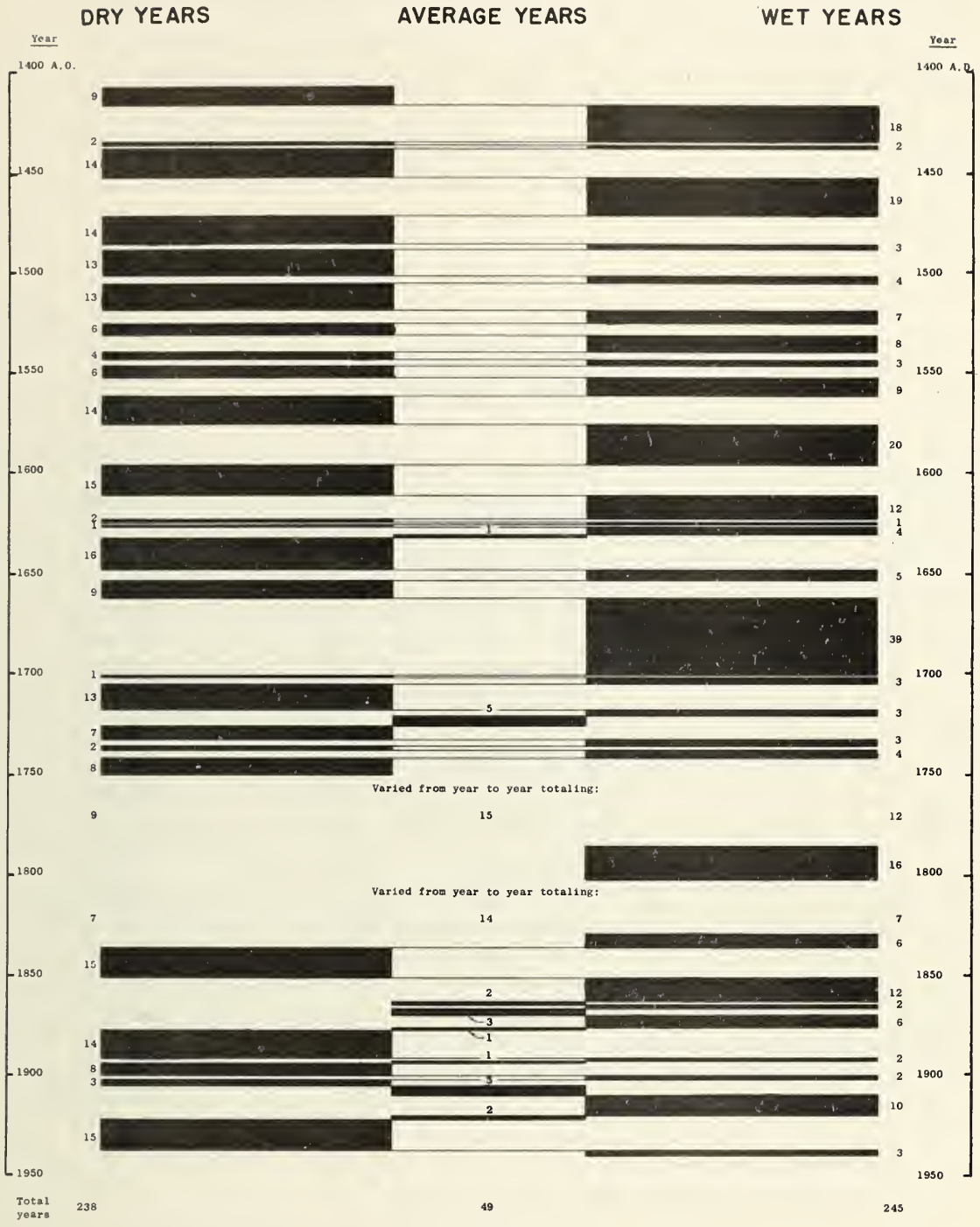
erosion, is characterized by steep-sided buttes and semi-barren mesas of striking form and color and is suitable primarily for grazing, forage, and mineral production. Trees persist only on the moister north slopes and in the deeper draws and coulees (fig. 3).

Climatic Factors Affecting Forest Distribution

Small amounts of moisture inadequately distributed, wide extremes of temperature, and drying winds are the three most important climatic factors restricting tree growth in North Dakota.

Periodic droughts are particularly effective in holding natural forests to moister sites where the trees can endure several successive years of dry weather. These cyclical variations in available moisture are illustrated by a study of tree-ring growth in North Dakota by George F. Wills (9). This study has produced an excellent chronological record of moisture availability and, hence, a fair measure of precipitation since about the year 1400 (fig. 4). Average annual rainfall is 17 inches, ranging from a maximum of 22 inches in the Red River Valley to a minimum of 14 inches on the Montana border.

FIGURE 4: CYCLIC VARIATION OF WET AND DRY YEARS IN CENTRAL NORTH DAKOTA, 1407-1939.



Recording a total of 532 years.

SOURCE: GEORGE F. WILL, 1946 (9).

Temperatures of this region are subject to the wide fluctuations typical of continental climates and can be tolerated by only a limited number of tree species. The maximum temperature spread thus far recorded in North Dakota is 184 degrees--from a high of 124°F. at Medora in 1912 to a low of -60°F. at Parshall in 1936. Chinook winds in the western part of the state have caused temperature rises of as much as 75°F. within a 24-hour period.

Without mention of the wind, the climatic picture of North Dakota would not be complete. Its chief retarding effect on vegetative growth is through desiccation of the soil by direct evaporation and increased transpiration. Although tornadoes do occur, straight blows by severe windstorms cause the most extensive damage; velocities of over 70 miles per hour are not uncommon.

FORESTS OF THE STATE

There are an estimated 466,800 acres of native forest land in North Dakota of which 451,000 acres are considered sufficiently productive to be classified as commercial forest land. Through the years, this area of natural woodland has been supplemented by nearly 90,000 acres of plantings (not included in survey statistics) composed largely of shelterbelts and windbreaks. Some of this planted area has reverted to prairie, but much of it survives and is a symbol of what can be done in establishing trees on the plains.

Native Forests

It is widely recognized that forests provide values both tangible and intangible beyond their price as raw materials for conversion into products of wood or fiber. In North Dakota, these "other values," often referred to as secondary, give timber its primary value. This report, however, deals with the more measurable aspects of forests, namely, those of area, species, volume, ownership, growth, and drain. A complete breakdown of statistics within these major divisions is presented later in this report.

Spotty Distribution of Forests

More than 60 percent of the forests in the state are found in three blocks--the Turtle Mountains, the Pembina Hills, and the vicinity of Devils Lake. An additional one-quarter is strung along the bottoms of the Missouri, Red, and Sheyenne Rivers and their tributaries. The small remainder is scattered in the Badlands, on lower north slopes of the Kildeer Mountains, in coulees along the canyon of the Little Missouri River, and in widely dispersed patches elsewhere in the state. Figure 5 locates these areas, their margins often being as sharply discernible on the ground as on the map.

Reductions in Area of Natural Forest Land

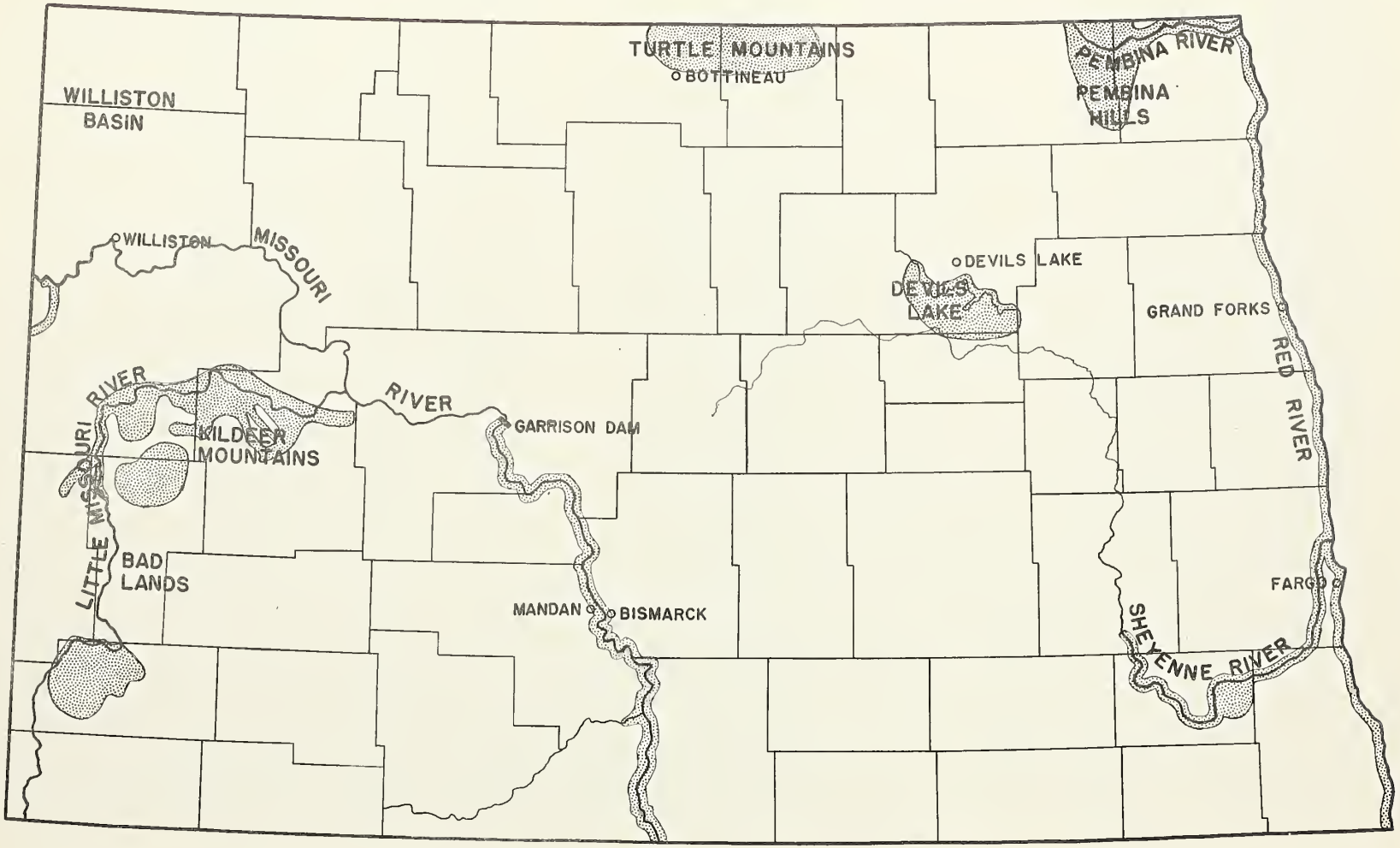
Some recent developments are causing a net reduction in the area of natural forest cover. The brisk demand in late years for agricultural land has resulted in a measure of land clearing in the Pembina Hills and in the Turtle Mountains. The construction of two large dams in the development program of the Missouri River Basin will drastically reduce the forested area along that river. When the Garrison Dam reservoir is filled it will inundate nearly all forest land upstream from the dam site to the confluence of the Missouri and Yellowstone Rivers near the North Dakota-Montana border. The Oahe dam, located not far north of Pierre, South Dakota, will form a reservoir extending northward to within 30 miles of Bismarck.

Description of Native Forest Types

North Dakota has a surprisingly large number of trees and shrubs common to its area. Interested readers are referred to a recent publication by the North Dakota School of Forestry at Bottineau, which describes and illustrates 16 tree and 13 shrub species of common occurrence and lists an additional 15 tree and 8 shrub species as found, "but probably not common enough to merit description. . . in this bulletin" (5).

Forest vegetation divides into six broad types which change from east to west. In the east along the Red, Pembina, and Sheyenne Rivers and their tributaries, the ash-elm type dominates many of the river flats where trees occur. In the Turtle Mountains, Pembina Hills, and the area south of Devils Lake, oak and aspen types appear far more frequently than others. In the central part along the flats of the Missouri River, cottonwood occurs most commonly. The typically western types of ponderosa pine and juniper (also called cedar) begin to appear in the Kildeer Mountain region and in the Badlands of the Little Missouri. This pattern is largely a matter of site, with moisture availability playing the critical role.

FIGURE 5 : NATURAL FOREST CONCENTRATIONS OF NORTH DAKOTA , 1954.



Ash-elm The ash-elm type is the most important of the six principal forest types occurring in the state in terms of both acreage and volume. It occupies nearly 35 percent (156,000 acres) of the state's forest area and accounts for approximately 60 percent of the total volume. It varies widely in species composition, quality, and form, ranging from scrubby clumps of green ash in some western parts of the state to a few stands of elm, basswood, and ash of good form, quality, and size in the Red and Missouri River valleys. For the most part, however, the ash-elm forests are stocked with rough and defective timber, making them more valuable as watershed, wildlife, and recreational areas than as a present or potential source of timber (fig. 6). Ash-elm, and basswood contribute 97 percent of the board-foot volume of the type.

Figure 6.--A young stand of ash-elm on a good site on the shoreline of Devils Lake.

Aspen

Although aspen trees occur widely over the state, the aspen type is concentrated chiefly in the Turtle Mountains and the Pembina Hills. It is found on 126,000 acres of land, comprising 28 percent of the state's forest area. Within much of this type the form and quality of the trees are poor; only 4 percent of the sawlog volume and 19 percent of the total forest volume in the state are made up of aspen and species associated with the aspen type.

The better sites for aspen in North Dakota are concentrated largely in the Turtle Mountains (fig. 7).

Figure 7.--A mature stand of aspen on the banks of Lyde Lake in the Turtle Mountains.

Bur oak

Bur oak, as a tree and as a type, is indigenous to the drier ridges and the southern slopes within the Pembina Hills and the Turtle Mountains, and to the area south of Devils Lake. The type is dominant over about 19 percent (84,000 acres) of the forest area and accounts for 12 percent of the forest volume. Growth, form, and size of trees are poor (fig. 8).

Figure 8.--Bur oak on a southeast slope in the Turtle Mountains. When trees are present on these drier exposures, the dominant type is principally bur oak.

Cottonwood

Cottonwood is found extensively along the bottoms of the Missouri River. It is commonly found in pure stands but occurs also as an occasional tree in the ash-elm type. The cottonwood type covers 10 percent of the state's forest area, provides 18 percent of the total forest volume, and 25 percent of the sawtimber volume. As a tree (Populus deltoides), it has moderately-good growth, form, and size characteristics; however, the larger trees frequently are defective (fig. 9).

In 1953 a statewide contest was held to find the largest tree in North Dakota. The winning tree was a cottonwood 4 miles southeast of Mayville, which measured 108 feet in height and 23 feet in circumference at $4\frac{1}{2}$ feet above the ground; it had a crown spread of 64 feet and an estimated age of approximately 300 years. Although extreme, this is indicative of the size which can be attained by this species.

Figure 9.--A pure stand of mature cottonwood on a Missouri River flood bank. Although of fair size and form, these trees contain considerable quantities of defect in the form of rot and shake.

Ponderosa pine and cedar

The ponderosa pine and cedar (Rocky Mountain juniper) types, which make up the only native softwood forests, constitute less than 1 percent of the state's forest resources. Found chiefly in the region of the Little Missouri River and the Kildeer Mountains, they mark the eastern limits of these types. Patches of pure juniper are commonly found in the Badlands (fig. 10).

The largest single concentration of ponderosa pine type in the state is a mixture of pine and Rocky Mountain juniper covering an area of about 2,000 acres on the south bank of the Little Missouri River about 10 miles northeast of Amidon. For nine years most of this tract was a part of the Dakota National Forest, established by Theodore Roosevelt in 1908. It was discontinued by Woodrow Wilson in 1917 because of its high cost of administration (7). Today there are hopes of setting apart this terrain or at least a portion of it, as a state park.

Figure 10.--A pure stand of juniper in the Badlands. It spreads and persists in the moister draws and coulees and on many slopes with northern and western exposures, but fails to become established on the drier sites.

Management of Native Forests

Native forests receive a bare minimum of attention. Most of them are grazed or freely accessible to cattle, while few are managed for the products they are fully capable of producing.

There is need for serious consideration of what forestry possibilities exist in these native woodlands. Based upon their productivity, how best can they be managed? Undoubtedly, many forested areas are more suited to game management than to forestry. How productive are the various types within different sections of the state? Is productivity sufficient to encourage the efforts of private owners in a program of woodland management? On which areas is applied management economically feasible? These are only a few of many questions which can best be answered through research, and which must be answered if management by private owners is to be made feasible.

Planted Forest Land

Most forestry activities in North Dakota are focused on planting trees in groves and strips. Both state and federal agencies encourage and actively participate in planting programs directed towards establishing shelterbelts and windbreaks. Protection of homes, livestock, soil, roads, pastures, crops, and wildlife is the chief function of these plantings, though incidental wood production does serve as a valuable by-product. Over the past 10 years, farmstead windbreaks (fig. 11) and field shelterbelts (fig. 12) have accounted for 94 percent of the planting activity. Miscellaneous plantings consisting largely of wildlife thickets, living snow fence, and field and gully settings, comprise the remaining 6 percent.

Early Planting Efforts

Efforts to encourage the planting and growing of trees on the plains began early but were largely ineffective. In 1863, when the Dakota Territory was opened for settlement, a 160-acre homestead was free to anyone over 21 years of age who would cultivate it, improve it, and live on it for 5 years. This was supplemented by the Timber Culture Act in 1873 which granted a settler partial title to a tree claim of an additional 160 acres if he planted 10 acres of this quarter-section in trees. A clear title to the land could be obtained when the trees were 8 years old. In 1905 the state legislature passed a tree bounty law providing monetary incentives for tree planting. As a result of these efforts some groves were established in the eastern and central parts of the state, but most of them were unsuccessful, largely because of insufficient knowledge on how to plant and care for trees on the prairie.

Figure 11.--A well-deployed, effective farmstead windbreak in the Red River Valley.

Figure 12.--A 5-row, mile-long field windbreak or shelterbelt in the Red River Valley.

During the early years of this century a number of railroad companies made extensive plantings along their lines over the northern Great Plains to protect them from snow. From 1905 to 1919 the Great Northern Railway planted more than 25 miles of protective belts along its main track between Grand Forks and Williston (8). Some of these are still effective after 50 years, (fig. 13).

Forest Research Has Helped

In 1912 the U. S. Department of Agriculture established the Northern Great Plains Field Station at Mandan. It was here in 1914 that the first systematic research in shelterbelt growth and survival was begun in an effort to discover and correct the causes contributing to the large number of failures in planted stands. The current status of this work is effectively summarized by two U. S. Department of Agriculture Circulars: "Tree and Shrub Species for the Northern Great Plains" and "31-Year Results in Growing Shelterbelts on the Northern Great Plains" (3 and 4).

Figure 13.--An early shelterbelt established by the Great Northern Railway, west of Leeds, North Dakota.

In 1929 the Lake States Forest Experiment Station, in cooperation with the North Dakota School of Forestry, initiated a forest research project near Denbigh. The original purpose of this project was to determine from experimental plantings the feasibility of establishing national forests on the sand plains. By 1937 the project indicated the plan was not feasible. Subsequent research showed that the best system would be to plant trees on the sand dunes, and on wind-eroded and other submarginal areas (about 10 percent of the land surface) to anchor the soil and prevent further erosion.

Recent Forestry Work

The dust storms of the thirties precipitated an ambitious drought-relief planting program known as the Prairie States Forestry Project. From 1935 to 1942, 30,223 belts were set out extending from the Canadian border into central Texas and covering a linear distance of 18,600 miles and an area of 238,000 acres (6). Of this area, 34,700 acres of belts extending over 2,645 miles were planted in North Dakota on 3,954 farms.

The School of Forestry at Bottineau has been active for more than 30 years in supplying planting stock and supervision for experimental plantings east of the 100th meridian. Other conservation offices promoting tree planting through extension, demonstration, planning, or active aid programs include the State Farm Forester, the State Extension Forester, the Soil Conservation Service, and the Fish and Wildlife Service.

The Soil Conservation Service has given a prominent place to tree planting in its programs of farm planning and active aid to owners. Since their initial shelterbelt and windbreak demonstration project was established at Park River, North Dakota, in 1935, the Service estimates it has helped establish some 54,400 acres of plantings throughout the state. These, together with the 34,700 acres of belts planted by the Prairie States Forestry Project, account for an estimated 96 percent of the plantings undertaken within the state. During the past 5 years the rate of planting has varied between 7,300 and 8,500 acres each year--ranking North Dakota first in the Plains States in the number of trees planted for protective purposes.

There are three public and four commercial nurseries producing seedlings for the state's forestry work. The two largest suppliers are Soil Conservation Service nurseries at Oakes and Fort Lincoln. These are owned by local SCS districts and are operated on a nonprofit basis. The third public nursery is the state-operated Clark-McNary unit, under the direction of the State Forester and management of the School of Forestry, with one division at Bottineau and a second at Towner. During the 1954 planting season public nurseries supplied approximately 75 percent of the required 5,900,000 seedlings, while commercial nurseries filled the remaining needs.

Cultivation is an essential step to successful belt establishment; the lack of it has been termed the bottleneck to increased planting in North Dakota. Basically, the problem is to cultivate both between rows and within rows to destroy competing vegetation. Recent machinery developments which will facilitate within-row cultivation may improve this situation.

Increased Planting Program Calls for More Research

The formula of trial and error plus research has gone far in overcoming numerous obstacles to establishing tree belts throughout the state. Often, solution of one problem leads to the discovery of one or more other problems. The need for research thus becomes a continuous and fundamental part of windbreak establishment and care.

Before planting can be successful on many areas, much more research will be essential. More needs to be known about planting methods, species arrangements adapted to soils and climate, and site requirements for major species. Also more effort is needed on the development of drought-resistant varieties through tree breeding and development. Such additional knowledge would make possible greater success in future plantings.

Table 1.--Land area, by major classes of land, North Dakota, 1954

Class of land 1/	Area	
	Thousand acres	Percent
Forest:		
Commercial	451.0	1.0
Noncommercial:		
Reserved from commercial timber use	3.2	*
Unproductive for timber use	12.6	.1
Total	466.8	1.1
Nonforest	44,369.7	98.9
Total all classes 2/	44,836.5	100.0

1/ See Appendix for definition of terms.
2/ From Census of Agriculture, 1950.
* Less than 0.05 percent.

Table 2.--Distribution of total land area and forest land area by major regions, North Dakota, 1954

Forest area 1/	All land area 2/	Total forest 3/	
	Thousand acres	Thousand acres	Percent
Concentrated areas:			
Turtle Mountains	341.9	126.9	37
Pembina Hills	286.3	71.4	25
Devils Lake	138.5	14.0	10
Red, Sheyenne, and Pembina Rivers	533.2	50.1	9
Missouri River	200.2	31.6	16
Little Missouri River and Kildeer Mountains	430.7	55.9	13
Badlands and misc. areas	236.4	8.8	4
Total area	2,167.2	358.7	17
Scattered areas 1/	42,669.3	108.1	*
All areas	44, 836.5	466.8	1

1/ See Appendix for definition of terms.
2/ From Census of Agriculture, 1950.
3/ Includes 3,200 acres of land reserved from commercial timber use, and 12,600 acres forested but considered unproductive for timber use.
* Less than 0.5 percent.

Table 3.--Commercial forest land area by ownership and stand-size class, North Dakota, 1954

(In thousands of acres)

Ownership class	Total	Sawtimber stands	Poletimber stands	Seedlings and saplings	Non-stocked
Federally owned or managed:					
Indian	71.4	11.0	28.5	25.9	6.0
Bureau of Land Mgt.	.5	.1	.2	.1	.1
Other federal	56.5	8.7	22.6	20.5	4.7
All federal	128.4	19.8	51.3	46.5	10.8
State 1/	10.5	1.6	4.2	3.8	.9
Farmer	182.1	28.1	72.7	65.9	15.4
Other private	130.0	20.1	51.9	47.0	11.0
All ownerships	451.0	69.6	180.1	163.2	38.1

1/ No county or municipal ownership was found in the state.

Table 4.--Net volume of live sawtimber and growing stock on commercial forest land by ownership class North Dakota - 1954

Ownership class	Growing stock	Sawlog material		Cordwood material
	Million cu. ft.	Million bd. ft.	Million cu. ft.	Million cu. ft.
Federally owned or managed:				
Indian	40.8	80.6	17.0	23.8
Bureau of Land Mgt.	.3	.6	.1	.2
Other	32.4	63.9	13.5	18.9
All federal	73.5	145.1	30.6	42.9
State[1/]	5.9	11.7	2.4	3.5
Private:				
Farmer	104.1	205.6	43.4	60.7
Other private	74.3	146.8	31.0	43.3
All private	178.4	352.4	74.4	104.0
All ownerships	257.8	509.2	107.4	150.4

1/ No county or municipal ownership was found in the state.

Table 5.--Commercial forest land by major forest type, stand-size, and density, North Dakota, 1954

(In thousands of acres)

Forest type	Total	Sawtimber		Poletimber		Seedling and sapling		Non-stocked
		Fair to well stocked	Poorly stocked	Fair to well stocked	Poorly stocked	Fair to well stocked	Poorly stocked	
Ponderosa pine	1.0	-	-	-	1.0	-	-	-
Juniper (cedar)	2.6	-	-	-	-	-	2.6	-
Ash-elm	155.6	41.4	4.1	20.3	33.0	18.6	38.2	-
Cottonwood	43.7	9.5	11.4	12.3	6.7	2.2	1.6	-
Aspen-birch	126.1	.9	-	40.7	30.6	46.9	7.0	-
Oak	83.9	.9	1.4	13.2	22.3	20.6	25.5	-
Upland brush	8.8	-	-	-	-	-	-	8.8
Lowland brush	29.3	-	-	-	-	-	-	29.3
Total	451.0	52.7	16.9	86.5	93.6	88.3	74.9	38.1
Percent	100	12	4	19	21	20	16	8

Table 6.--Net volume of live sawtimber and growing stock on commercial forest land, by species and stand-size class, North Dakota, 1954

Species	Total		Sawtimber stands		Poletimber stands		Seedling and sapling stands		Nonstocked stands	
	Sawtimber	Growing stock	Sawtimber	Growing stock	Sawtimber	Growing stock	Sawtimber	Growing stock	Sawtimber	Growing stock
	Million bd. ft.	Million cu. ft.	Million bd. ft.	Million cu. ft.	Million bd. ft.	Million cu. ft.	Million bd. ft.	Million cu. ft.	Million bd. ft.	Million cu. ft.
Ponderosa pine	-	0.2	-	-	-	0.2	-	-	-	-
Juniper (cedar)	-	*	-	-	-	-	-	-	-	-
Total softwood	-	0.2	-	-	-	0.2	-	-	-	-
Ash	58.9	36.4	35.7	13.3	23.2	20.2	-	2.8	-	0.1
Elm	149.3	38.3	136.8	30.6	3.0	5.0	5.3	1.8	4.2	0.9
Basswood	80.0	21.9	77.9	19.7	2.1	2.0	-	0.2	-	-
Oak	59.1	31.8	36.9	9.3	15.0	15.4	7.2	7.1	-	-
Cottonwood	129.3	52.7	111.3	28.4	17.2	23.1	0.8	1.2	-	-
Aspen	9.0	49.1	-	0.1	8.8	43.5	-	5.4	0.2	0.1
Balsam poplar	6.3	11.9	-	-	6.3	10.7	-	1.2	-	-
Paper birch	5.5	5.3	-	-	5.5	4.7	-	0.6	-	-
Box elder	6.3	7.8	6.3	3.9	-	1.8	-	0.7	-	1.4
Other hardwoods	5.5	2.4	5.5	2.1	-	0.3	-	-	-	-
Total hardwood	509.2	257.6	410.4	107.4	81.1	126.7	13.3	21.0	4.4	2.5
All species	509.2	257.8	410.4	107.4	81.1	126.9	13.3	21.0	4.4	2.5

* Less than 0.05 million cubic feet.

Table 7.--Net volume of all live timber on commercial forest land by species and stand-size class, North Dakota, 1954

Species	All volume	Growing stock							Other material	
			Sawlog material			Cordwood material			Limbs of hardwood	
		Total	Total	In sawtimber stands	In other stands	Total	Upper stem of sawtbr. trees	Pole trees	sawtimber trees	Cull trees
	Million cu. ft.	Million cu. ft.	Million bd. ft.	Million bd. ft.	Million bd. ft.	Million cu. ft.	Million cu. ft.	Million cu. ft.	Million cu. ft.	Million cu. ft.
Ponderosa pine	0.2	-	-	-	-	0.2	-	0.2	-	*
Juniper (cedar)	*	-	-	-	-	*	-	*	-	*
Total softwood	0.2	-	-	-	-	0.2	-	0.2	-	*
Ash	47.1	10.3	58.9	35.7	23.2	26.1	2.3	23.8	1.7	9.0
Elm	65.5	25.6	149.3	136.8	12.5	12.7	5.1	7.6	5.9	21.3
Basswood	37.7	14.0	80.0	77.9	2.1	7.8	3.0	4.8	6.1	9.8
Oak	44.4	10.0	59.1	36.9	22.2	21.8	2.0	19.8	2.3	10.3
Cottonwood	66.0	23.3	129.3	111.3	18.0	29.4	4.8	24.6	5.1	8.2
Aspen	52.9	1.6	9.0	-	9.0	47.5	0.4	47.1	0.2	3.6
Balsam poplar	12.2	1.2	6.3	-	6.3	10.8	0.2	10.6	0.2	*
Paper birch	5.8	1.1	5.5	-	5.5	4.2	0.2	4.0	0.1	0.4
Box elder	43.9	1.1	6.3	6.3	-	6.7	0.3	6.4	0.2	35.9
Other hardwoods	3.1	0.7	5.5	5.5	-	1.7	0.2	1.5	0.1	0.6
Total hardwood	378.6	88.9	509.2	410.4	98.8	168.7	18.5	150.2	21.9	99.1
All species	378.8	88.9	509.2	410.4	98.8	168.9	18.5	150.4	21.9	99.1
Percent	100	23	100	81	19	45	5	40	6	26

* Less than 0.05 million cubic feet.

Table 8.--Net volume of live sawtimber on commercial forest land by diameter class groups and species, North Dakota, 1954

(In millions of board feet)

Species[1/]	Total	D.B.H. class in inches				
		12	14	16	18	20+
Ash	58.9	25.9	9.2	15.9	7.9	-
Elm	150.5	19.2	23.3	30.6	17.9	59.5
Basswood	80.0	14.7	27.6	25.6	8.4	3.7
Oak	59.1	6.0	9.4	8.7	-	35.0
Cottonwood	129.3	21.6	20.4	20.9	22.9	43.5
Aspen	9.0	6.9	2.1	-	-	-
Balsam poplar	6.3	1.8	2.3	2.2	-	-
Paper birch	5.5	4.9	0.6	-	-	-
Box elder	6.3	4.8	0.1	1.4	-	-
Other hardwoods	4.3	0.3	2.1	1.5	0.4	-
Total hardwoods	509.2	106.1	97.1	106.8	57.5	141.7
Percent	100	21	19	21	11	28

1/ No softwood sawtimber was found in North Dakota.

Table 9.--Net annual growth, annual mortality, and commodity drain on live sawtimber and growing stock on commercial forest land, North Dakota, 1954

Item	Sawtimber			Growing stock		
	Total	Softwoods	Hardwoods	Total	Softwoods	Hardwoods
	Million bd. ft.	Million bd. ft.	Million bd. ft.	Million cu. ft.	Million cu. ft.	Million cu. ft.
Net annual growth	28.2	-	28.2	10.3	-	10.3
Annual mortality	9.6	-	9.6	5.3	-	5.3
Commodity drain[1/]						
Lumber	2.0	-	2.0	0.4	-	0.4
Fuelwood	1.1	-	1.1	1.1	-	1.1
Fence posts	1.6	0.1	1.5	1.7	0.1	1.6
Logging waste	0.4	-	0.4	0.3	-	0.3
Total	5.1	0.1	5.0	3.5	0.1	3.4
All drain	14.7	0.1	14.6	8.8	0.1	8.7

1/ There is negligible or no drain for the following timber products: Veneer, cooperage, or pulpwood logs and bolts; piling; poles; ties; and mine timbers.

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APPENDIX

Definition of Terms

Land Area

Land area.-- Includes dry land and land temporarily covered with water, streams less than 1/8-mile in width, and ponds less than 40 acres in area. Source: United States Census of Agriculture, 1950, U. S. Department of Commerce, Bureau of the Census.

Forest land area.--Includes (a) lands which are at least 10 percent stocked by trees of any size and capable of producing timber or other wood products, or of exerting an influence on the climate or on the water regime; (b) land from which the trees described in (a) have been removed to less than 10 percent stocking and which have not been developed for other use; and (c) afforested areas. (Timbered tracts of less than 1 acre or forested strips of less than 120 feet wide are not included.)

Concentrated forest land area.--Requires a minimum area of 5,000 acres of forest land in blocks at least 5 percent wooded.

Scattered forest land area.--Includes areas less than 5 percent wooded and blocks with fewer than 5,000 acres of forest land.

Commercial forest land area.--Forest land which is (a) producing or physically capable of producing usable crops of wood (usually sawtimber), (b) economically available now or prospectively, and (c) not withdrawn from timber utilization.

Noncommercial forest land area.--Forest land (a) withdrawn from timber utilization through statute, ordinance, or administrative order but which otherwise qualifies as commercial forest land, and (b) incapable of yielding usable wood products (usually sawtimber) because of adverse site conditions.

Forest Types

A forest type is classified with respect to species predominant volume-wise in the stand regardless of stand size. For example, the ash-elm type is a stand of bottomland hardwood species in which ash and elm predominate. Six types were recognized in North Dakota: Ash-elm, aspen-birch (trembling aspen and paper birch), cottonwood, oak (bur oak), juniper, and ponderosa pine.

Forest Stand-Size Classes

Sawtimber stands.--Stands with sawtimber trees having a minimum net volume per acre of 1,500 board feet, International 1/4-inch rule.

Poletimber stands.--Stands failing to meet the sawtimber stand specification, but at least 10 percent stocked with poletimber and larger (5.0 inches diameter at breast height and larger) trees with at least half the minimum stocking in poletimber trees.

Seedling and sapling stands.--Stands not qualifying as either sawtimber or poletimber stands, but having at least 10 percent stocking of trees of commercial species and with at least half the minimum stocking in seedling and sapling trees.

Tree Classes

Sawtimber trees.--Trees of commercially used species meeting regional use requirements for soundness and form, with a minimum diameter at breast height of 11.0 inches for hardwoods and 9.0 inches for softwoods.

Poletimber trees.--Trees of commercially used species meeting regional use requirements for soundness and form, with a diameter range at breast height of 5.0 to 10.9 inches for hardwoods and 5.0 to 8.9 inches for softwoods.

Cull trees.--Live trees of sawtimber or poletimber size that are unmerchantable for sawlogs now or prospectively because of defect.

Timber Volume

Net volume.--Gross wood volume less deductions for rot and defect.

All timber volume.--Net volume in cubic feet of live and salvable dead sawtimber trees and poletimber trees of commercial species, and of cull trees of all species from stump to a minimum 4.0-inch top diameter inside bark. Includes bole only of softwoods but bole and limbs of hardwoods to a minimum 4.0-inch top diameter (of central stem) inside bark.

Upper stem portion.--Net volume in cubic feet of bole of sawtimber trees between merchantable top and a point on the bole with a minimum top 4.0 inches in diameter inside bark when it exists.

Hardwood limbs.--Limbs of live hardwood sawtimber trees and sawtimber-size cull hardwood trees to a minimum diameter of 4.0 inches inside bark.

Growth

Net annual growth.--The change in net volume of growing stock on commercial forest land for a specified year.

Mortality

Annual mortality of growing stock.--The net cubic-foot volume removed from growing stock during a specified year through death from natural causes.

Drain

Timber products output.--The volume of timber products cut from growing stock and other sources.

Forest Survey Methods

Area

In North Dakota two broad strata (called concentrated and scattered areas) were dot-sampled to determine the forest land areas. ASC photos with a scale 8-inches-to-the-mile were used. Thirty-nine of the 53 counties in the state were sampled, (see accompanying table).

Surveyed counties in North Dakota with total land area and commercial forest area, 1954

County	Land area 1/	Commercial forest area 2/	
	Thousand acres	Thousand acres	Percent
Adams	634	.2	.03
Barnes	957	2.1	.22
Benson	915	9.6	1.05
Billings	729	11.8	1.62
Bottineau	1,087	45.1	4.15
Burke	717	.5	.07
Burleigh	1,072	6.1	.57
Cass	1,119	10.9	.97
Cavalier	968	51.4	5.31
Dickey	732	.8	.11
Dunn	1,324	37.3	2.82
Eddy	412	2.0	.49
Emmons	989	4.5	.46
Golden Valley	649	0	0
Grand Forks	920	19.5	2.12
Grant	1,070	.8	.07
Griggs	457	3.0	.66
Hettinger	726	.2	.03
Logan	642	0	0
McKenzie	1,819	19.3	1.06
McLean	1,464	7.6	.52
Mercer	710	2.0	.29
Morton	1,244	4.9	.39
Oliver	461	3.1	.67
Pembina	719	47.3	6.58
Pierce	674	.2	.03
Ramsey	777	4.8	.62
Ransom	552	6.1	1.11
Richland	934	4.8	.51
Rolette	600	82.1	13.68
Sargent	547	3.0	.55
Slope	785	5.4	.69
Sioux	725	4.4	.61
Stutsman	1,455	3.8	.26
Towner	668	.9	.13
Trail	551	4.1	.74
Walsh	826	2.1	.25
Ward	1,311	3.3	.25
Williams	1,344	1.0	.07
Total	34,285	416.0	1.21

1/ From Census of Agriculture, 1950.
2/ See Appendix for definition of terms.

Concentrated areas.--One hundred percent coverage was achieved by laying a 20-dot grid over alternate photos in every flight line (alternate photos give full coverage). Forest area proportions were determined by counting and classifying the points as forest, nonforest, or water. A photo-determined description indicating type, size class, and density was given for a $2\frac{1}{2}$-acre area surrounding each fourth forest dot. To verify and adjust these photo classifications, every fifth photo-classified forest dot was ground checked.

Scattered areas.--Twelve-and-one-half percent coverage was achieved by laying a 100-dot grid over every fourth photo in every fourth flight line. The field procedure from this point on corresponds to the description given under "concentrated areas."

Volume and Growth

The volumes on 1/5-acre circular plots were tallied at each ground-check point that was classified as sawtimber or poletimber, at alternate check points classified as restocking, and at every fourth nonstocked or noncommercial classified point. Growth data were computed from sample tree measurements recorded at each ground-check point. Sample trees were selected as follows:

1. Every sawtimber tree on the NE-$\frac{1}{4}$ of the 1/5-acre plot.

2. Every poletimber tree on a 1/50-acre plot at the center of the 1/5-acre plot.

3. Every tree in the 4-inch d.b.h. class on the NE-$\frac{1}{4}$ of the 1/50-acre plot.

Commodity Drain

All known sawmill owners were contacted for an estimate of their production. No other wood-using industries are present in North Dakota. To arrive at an estimated volume use for fuelwood and fence posts, the landowner nearest each ground-check point was contacted and his requirements recorded.

Accuracy of Estimates

The errors of estimates in this report are attributable to sampling errors and to human errors in classifying, cruising, and computing. Human errors were held to a minimum by careful training and painstaking work. Calculations of standard error indicate that the chances are 2 out of 3 that the estimated forest area is within $\pm$ 2.9 percent of the actual forest area, and that the estimated total volume is within $\pm$ 3.2 percent of the actual volume. Statistical accuracy of any portion of the area or volume varies with size of the figures; the larger the quantity, the smaller the sampling error associated with it.

The following material has been prepared for readers who may wish to compare statistics for North Dakota with those in other Forest Survey state reports. When any one of the 10 standard tables appears in the body of the report only its caption has been given together with the page number on which it can be found.

Table I.--Land area by major classes of land, 1954. . . . . .page 21.

Table II.--Commercial forest land area by ownership and stand-size class, 1954. . . . . .page 23.

Table III.--Area of commercial forest land by major forest types, 1954

Forest type	Thousand acres
Ponderosa pine	1.0
Juniper (cedar)	2.6
Ash-elm	155.6
Cottonwood	43.7
Aspen-birch	126.1
Oak	83.9
Upland brush	8.8
Lowland brush	29.3
Total	451.0

Table IV.--Net volume of live sawtimber and growing stock on commercial forest land by stand-size class, 1954

Stand-size class	Sawtimber	Growing stock
	Million bd. ft.	Million cu. ft.
Sawtimber stands	410.4	107.2
Poletimber stands	81.1	127.1
Seedling and sapling stands	13.3	21.0
Nonstocked and other areas not elsewhere classified	4.4	2.5
Total	509.2	257.8

Table V.--Net volume of live sawtimber and growing stock on commercial forest land by ownership class, 1954

Ownership class	Sawtimber	Growing stock
	Million bd. ft.	Million cu. ft.
Federally owned or managed:		
National forest	-	-
Indian	80.6	40.8
Other	64.5	32.7
Total	145.1	73.5
State	11.7	5.9
County and municipal	-	-
Private:		
Farm	205.6	104.1
Industrial and other	146.8	74.3
Total	352.4	178.4
All ownerships	509.2	257.8

Table VI.--Net volume of live sawtimber and growing stock on commercial forest land by species, 1954

Species	Sawtimber	Growing stock
	Million bd. ft.	Million cu. ft.
Softwoods:		
Ponderosa pine	-	.2
Juniper (cedar)	-	(1/)
Total	-	.2
Hardwoods:		
Ash	58.9	36.4
Elm	149.3	38.3
Basswood	80.0	21.9
Oak	59.1	31.8
Cottonwood	129.3	52.7
Aspen	9.0	49.1
Balsam poplar	6.3	11.9
Paper birch	5.5	5.3
Box elder	6.3	7.8
Other hardwoods	5.5	2.4
Total	509.2	257.6
All species	509.2	257.8

1/ Less than 0.05 million cubic feet.

Table VII.--Net volume of live sawtimber on commercial forest land by diameter class groups and species, 1954. . . . . page 28.

Table VIII.--Net volume of all timber on commercial forest land by class of material and species group, 1954

Class of material	Total	Softwoods	Hardwoods
	Million cu. ft.		
Growing stock:			
Sawtimber trees:			
Sawlog portion	88.9	-	88.9
Upper stem portion	18.5	-	18.5
Total	107.4	-	107.4
Poletimber trees	150.4	-	150.4
Total growing stock	247.8	-	257.8
Other material:			
Sound cull	59.4	-	59.4
Rotten cull	39.7	-	39.7
Hardwood limbs	21.9	-	21.9
Salvable dead	(1/)	-	(1/)
Total other material	121.0	-	121.0
Total all timber	378.8	-	378.8

1/ Less than 0.05 million cubic feet.

Table IX.--Net annual growth, annual mortality, and commodity drain on live sawtimber and growing stock on commercial forest land, by species groups, 1954. . . . . page 29.

Table X.--Total output of timber products and commodity drain on live sawtimber and growing stock, 1954

Product	Volume of product cut[1]			Commodity drain on sawtimber			Commodity drain on growing stock		
	Standard unit	Number	Thousand cu. ft.	Total	Softwoods	Hardwoods	Total	Softwoods	Hardwoods
				Million board feet			Million cubic feet		
Sawlogs	M bd. ft.[2]	2,350	447	2.0	-	2.0	0.4	-	0.4
Veneer logs and bolts	M bd. ft.	-	-	-	-	-	-	-	-
Cooperage logs and bolts	M bd. ft.	-	-	-	-	-	-	-	-
Pulpwood logs	M bd. ft.	-	-	-	-	-	-	-	-
Pulpwood bolts	Std.cords[3]	-	-	-	-	-	-	-	-
Fuelwood	Std.cords[3]	40,000	1,084	1.1	-	1.1	1.1	-	1.1
Piling	M linear ft.	-	-	-	-	-	-	-	-
Poles	M pieces	-	-	-	-	-	-	-	-
Posts	M pieces	2,550	1,712	1.6	0.1	1.5	1.7	0.1	1.6
Hewn ties	M pieces	-	-	-	-	-	-	-	-
Mine timbers	M cu. ft.	-	-	-	-	-	-	-	-
Miscellaneous[4]	M cu. ft.	-	-	-	-	-	-	-	-
Total			3,243	4.7	0.1	4.6	3.2	0.1	3.1

1/ Includes material from both growing stock and other miscellaneous sources.
2/ International 1/4-inch rule.
3/ Roughwood basis.
4/ Includes chemical wood, excelsior, handle stock, shingle bolts, etc.